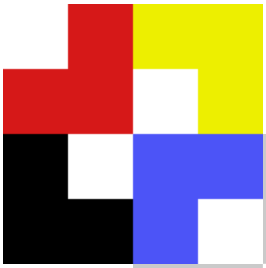

Depth of field

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Control over the sharp and unsharp parts of the image can be of considerable importance for the success of a photograph. Traditionally, the depth of field (DOF) is a great source of confusion among photographers. To blur or not to blur, that is the question. The latter is a matter of DOF, the former not per se.

Depth of field is defined as the range of object distances within which objects are imaged with acceptable sharpness. [1]

A whole series of definitions can be found at Don Fleming's site, where a casual glance suffices to conclude that they all amount to the same thing. That is a welcome observation, because it means that there is consensus of opinion regarding the definition of DOF.

The concept of DOF

Depth of field can be treated in a theoretical framework that I will refer to as a concept. This concept is very useful because it enables extensive calculations and comparisons within the relatively simple theory of Gaussian optics. For this purpose it is assumed that the lenses are free of aberrations and that diffraction is nonexistent. The film (or digital sensor) is supposed a grainless recorder of the finest details, so that the image can be freely enlarged without loss of definition. All this is not true, but as long as we restrict ourselves to 'normal' photographic scenarios, the concept can be equated to practice with some confidence. The theory is on a separate page to preserve readability, but I will occasionally refer to an equation.

Viewing conditions

There is a difference between calculated sharpness and perceived sharpness. For the perceived or apparent depth of field, the lighting conditions are important, as a well-illuminated print will more easily reveal imperfections than the same print in a dim room. Further, an observer with a high visual acuity may reject a print that satisfies another observer with poor vision. A very important factor is the viewing distance in relation to the size of the photograph. Obviously, a large print viewed from close is much more demanding than a small print viewed from a large distance. Within the concept of DOF it is usually assumed that the print viewing distance does not depend on the picture taking lens. There is a good reason for this, for most people do not change seats during a slide presentation and at an exposition they examine the various photographs from similar distances. The concept of DOF is adapted to these habits, since the DOF scales imprinted on lenses are based on a sharpness criterion that does not depend on the focal length. Likewise, a typical DOF calculator will suggest -or may even impose- a sharpness criterion based on the film format, independent of the lens focal length. Bear in mind, however, that many of the conclusions reached in the remainder of this article would be different if we had assumed 'perspectively correct' viewing, i.e. a viewing distance in proportion to the focal length [2].

Circle of confusion

To calculate the depth of field, one needs a sharpness criterion. This criterion is taken as the so-called circle of confusion (COC). A COC value corresponds to the blur spot diameter, measured on the film/sensor, of an unsharply imaged point in object space. In DOF calculations it is customary to use the designation COC for the largest **permissible** circle of confusion. The blur disk diameter is zero for points in the plane of sharp focus and progressively grows as we move forward or backward from this plane in object space. However, as long as the blur disk is smaller than the acceptable